

CLAIMS

- 1 1. A vehicle framing system for framing a vehicle body from a
2 plurality of separate body components, at least one of the vehicle body
3 components having a reference surface, comprising:
4 an assembly station having spaced-apart frame members;
5 a vehicle carrier which supports the vehicle body components in a
6 preassembled condition at said assembly station;
7 at least two docking stations secured to each frame member at
8 predetermined positions;
9 a tool arm associated with each docking station;
10 a robot associated with each tool arm for moving said tool arm between
11 an assembly position in which each said tool arm abuts against its associated
12 docking station at a predetermined position, and a vehicle loading position in
13 which each tool arm is disengaged from its associated docking station;
14 a tool arm clamp associated with each docking station which clamps
15 said tool arm to its associated docking station at said predetermined position
16 when said tool arm in said assembly position; and
17 at least one reference block with its associated framing clamp secured
18 to each tool arm, each framing clamp releasably clamping its associated tool
19 arm across the at least one reference surface to maintain it in contact with its
20 reference block, on at least one vehicle body component to thereby maintain
21 said vehicle body components at a predetermined position relative to each
22 other.

1 2. The invention as defined in claim 1 and comprising means for
2 selectively detachably connecting each robot with its associated tool arm.

1 3. The invention as defined in claim 1 and comprising a welding
2 gun connected to at least one of said robots.

1 4. The invention as defined in claim 3 wherein the welding robots
2 are sized to carry and dynamically move their associated tool arms without
3 having to disconnect from their welding guns.

1 5. The invention as defined in claim 1 wherein, with said tool arms
2 at their respective assembly positions, at least a portion of at least one tool arm
3 extends into an interior of the vehicle body components.

1 6. The invention as defined in claim 1 wherein each docking
2 station includes three spaced locator pins, each locator pin having a predefined
3 locating surface, and wherein each tool arm includes three locator sockets, each
4 tool arm locator socket having a locating surface complementary to and aligned
5 with said docking station locating pins.

1 7. The invention as defined in claim 6 wherein said docking station
2 locator pins are frusto-conical in shape.

1 8. The invention as defined in claim 6 wherein said docking station
2 locator pins are positioned at the apices of a triangle.

1 9. The invention as defined in claim 6 wherein frusto-conical
2 locator pins have a preferred conicity angle of 90 degrees.

1 10. The invention as defined in claim 8 wherein said locator pins are
2 in a plan preferably oriented at 45 degrees from the horizontal.

1 11. The invention as defined in claim 8 wherein said tool arm clamp
2 is aligned with the centroid of said triangle.

1 12. The invention as defined in claim 11 wherein said tool arm
2 clamp remains clamped in case of power outage (type activate for release).

1 13. The invention as defined in claim 6 and comprising a media
2 quick connector for pressurized air and electric communication in between the
3 docking station and tool arm, said media being used to activate and control said
4 inboard framing clamp and locating pin cylinder.

1 14. The invention as defined in claim 1 wherein the tool arm main
2 body has a tetrahedral shape with a triangular basis matching the pattern of the
3 locating socket outer perimeter.

1 15. The invention as defined in claim 1 and comprising a conveyor
2 which moves said vehicle carrier to said framing station.

1 16. The invention as defined in claim 1 wherein said robot includes
2 a coupler which selectively engages its associated tool arm.

1 17. A method for framing a vehicle body from a plurality of
2 separate body components, at least one of the vehicle body components having
3 a reference surface, comprising the steps of:

4 moving the vehicle body in a preassembled condition to an assembly
5 station between spaced apart framing members;

6 moving a plurality of tool arms by robots into abutment with docking
7 stations formed on the framing members so that the tool arms are at predefined
8 positions with respect to the framing members, one robot being associated with
9 each tool arm;

10 clamping said tool arms to said docking stations; and

11 clamping said tool arms to beam body reference surfaces to maintain
12 them in contact with the stationary reference blocks mounted onto said tool

13 arm to thereby maintain the vehicle body components in a predetermined
14 position relative to each other.

1 18. The invention as defined in claim 17 and further comprising the
2 steps of:
3 disengaging at least one robot from its associated tool arm;
4 welding said vehicle body components together by welders carried by
5 said at least one disengaged robot;
6 reengaging said at least one disengaged robot with its associated tool
7 arm;
8 unclamping said tool arms from said docking stations; and
9 removing said tool arms from said docking stations by said robots.